R&D Intensity, Knowledge Creation Process and New Product Performance: The Mediating Role of International R&D Teams

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Abstract

Although previous studies have shown the positive effect of research and development (R&D) intensity on new product performance (NPP), our understanding about the mechanisms through which R&D intensity influence NPP is less understood. In this paper, we focus on the mediating role of international R&D teams in explaining the effect of R&D intensity on NPP. Since R&D teams are dispersed across the globe, thus examining the role of international R&D teams will provide a more nuanced understanding of the mechanisms through which R&D intensity contributes to NPP. Using survey data from 201 Ghanaian firms engaged in internationalisation activities, the results suggest that the use of international R&D teams mediates the relationship between R&D intensity and NPP. Moreover, the findings indicate that the use of international R&D teams improves NPP and that this linkage is amplified when the knowledge creation process inside the firm is stronger. We discuss the implications of these findings for theory and practice.

Keywords: *R&D intensity; new product performance; international R&D teams; knowledge creation process; SMEs; Africa; Ghana*

1. Introduction

In an increasingly multifaceted global environment, no organization can afford to rely exclusively on sole stars rather than teams to deliver enduring success and innovate (Groysberg, 2010; Groysberg, Lee & Nanda, 2008; Groysberg & Abrahams, 2006;

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Groysberg, & Lee, 2009; Groysberg, Lee & Nanda, 2008). Recent scholarly advances indicate that stars actually require an effective supportive culture to deliver superior performances and that the notion of 'sole stars' is a myth (Amankwah-Amoah, 2015; Amankwah-Amoah & Sarpong, 2014; Groysberg, 2010; Groysberg & Abrahams, 2006). By being isolated from networks and support workers, such stars' performance often declines and/or is rendered ineffective in different organizational contexts (Groysberg & Abrahams, 2006).

Consequently, multinational enterprises (MNEs) are increasingly internationalizing their R&D functions and tapping into diverse knowledge spread across the global networks of emerging and developed markets (Ambos & Schlegelmilch, 2003; Awate et al., 2015; Subramaniam & Venkatraman, 2001). This research stream emphasizes the importance of international teams to organizations not only in terms of knowledge acquisitions, utilization and new product development (Frost & Zhou, 2005; Sarin & McDermott, 2003; Vahtera et al., 2017), but also for safeguarding the long-term survival of firms and their ability to develop new product development capability (Subramaniam & Venkatraman, 2001), thus improving new product performance (NPP).

Arguably, a principal tenet of many successful organizations is increasingly predicated on the ability to assemble, develop and utilize cross-functional teams spanning geographical context (Sarin & McDermott, 2003; Vahtera et al., 2017). By mobilizing and utilizing diverse teams, organizations become well-endowed to be able to develop creative solutions and make better decisions (Curşeu, Schruijer, & Boroş, 2007). By deploying international R&D teams, firms are in a better position to generate novel knowledge which in turn improves innovation (Paruchuri & Eisenman, 2012). However, cultivating and nourishing teams across borders is often time consuming and requires a high level of skills to curtail any sources of conflict and mistrust. More so, cross-cultural differences or conflicts can hamper the productivity of

international teams (see Ambos & Schlegelmilch, 2004), which further hinders the coordination of knowledge collaboration across R&D units (e.g., Vahtera et al., 2017).

Despite the progress made toward understanding the importance of international research and development (R&D) teams (Ambos & Schlegelmilch, 2004) and the manner in which they influence innovation (Vrontis & Christofi, 2019), it remains unclear whether the use of international R&D teams could play a role in the relationship between R&D investment and new product success in small medium-sized enterprises (SMEs) especially in the context of emerging markets. Thus, our understanding of the exact mechanisms through which R&D intensity enhances NPP is relatively underexplored. Since R&D teams are dispersed across the globe (see also Bustinza, Gomes, Vendrell-Herrero & Baines, 2019; Vrontis & Christofi, 2019), understanding the role of international R&D teams in SMEs could be a mechanism to develop a fine-grained understanding about the exact impact of R&D intensity on NPP. Understanding whether NPP is sustained or hampered by R&D investment and international R&D teams in SMEs is important because the vast majority of firms in the world economy are SMEs (Miller, Steier & Le Breton-Miller, 2003). In addition, we still do not know enough of the effect of the use of international R&D teams on NPP and the condition under which the use of international R&D teams is more or less pronounced in NPP. In particular, the paucity of research into the use of international R&D teams and NPP in emerging market contexts is relatively underexplored. However, the literature indicates that the beneficial effects of the use of international R&D teams for firms may be context specific as opposed to being universally applicable (Bustinza, Gomes, Vendrell-Herrero & Baines, 2019). Thus, the paper seeks to address the above knowledge gaps in the literature. Specifically, we investigate the following research questions: *(1) to what extent does R&D intensity affect the use of international R&D teams?, (2) To what extent does the use of*

international R&D teams influence NPP?, and (3) How does knowledge creation process moderate the relation between international R&D teams and NPP?

This study adds to previous research in several ways. First, by establishing links between the R&D investment, international R&D teams and research on NPP, this paper contributes to our understanding of the underexplored R&D intensity–NPP relationship in emerging market small entrepreneurial international ventures. Thus, we contribute to the innovation literature by showing the underlying mechanisms through which firms' R&D investment influences the success of new products in SMEs. In addition, we contribute to the literature on product innovation performance (Alegre & Chiva, 2008; Luca, & Atuahene-Gima, 2007) by offering a deeper understanding of the moderating effects of knowledge creation processes. In addition, utilizing insights from the knowledge-based perspective of the firm (Nickerson & Zenger, 2004) and NPP (Alegre & Chiva, 2008; Atuahene-Gima, Slater & Olson, 2005; Bustinza, Vendrell-Herrero & Gomes, 2019), we develop a model that elucidates our understanding of how knowledge creation processes play a moderating role on the association between the use of international R&D teams and NPP.

2. Theoretical framework and hypotheses development

According to the knowledge-based view (e.g., Grant, 1996; Nonaka, 1994; Nonaka & Takeuchi, 1995), a firm must actively create knowledge to be able to compete with its rivals. As has been acknowledged in the knowledge management literature (Grant, 1996; Nonaka & Toyama, 2005; Nonaka & Konno, 1998), the knowledge creation process is extremely important for firms to develop new product or marketing strategies (Joshi & Sharma, 2004; Kim & Atuahene-Gima, 2010). Knowledge creation and possession of valuable resources could enhance the competitive advantage of firms that are serving international markets. Indeed, employees could utilize collective knowledge to better serve customers' needs. To

obtain sustained competitive advantage, firms' abilities in acquiring, retaining, integrating and creating knowledge across domestic and global markets are paramount.

The literature has identified four knowledge creation processes (see Nonaka, 1994): socialization, externalization, combination and internalization. According to the notion of this model (Nonaka, 1994; Nonaka & Toyama, 2005), socialization reflects a process that converts tacit knowledge held by individuals into new tacit knowledge. This is done through shared experiences and joint activities (e.g., apprenticeships or social interaction of organizational members). The firm could extend its socialization process through networks to other entities as the community of social interaction goes beyond the boundaries of the firm to include customers, suppliers and competitors. Externalization of knowledge reflects how tacit knowledge is converted to explicit knowledge that is understood by others. This can be in the form of metaphors, analogies or dialogues (Nonaka & Takeuchi, 1995). Combination denotes the conversion of explicit knowledge obtained within the firm or externally acquired knowledge. This type of knowledge creation process may be reflected in action and practice. The last type of knowledge creation process is the internationalization process, which reflects the process where explicit knowledge is transferred into tacit knowledge. With this type of knowledge creation process, employees can acquire and absorb knowledge by demonstration or learning by doing on the job (Nonaka & Takeuchi, 1995; Nonaka et al., 2000b).

To integrate the knowledge creation process into our research framework, we utilized the socialization, externalization, combination and internalization (SECI) model (Nonaka, 1994) based on several reasons. First, the SECI model is considered as a knowledge creation theory exploring the relationships between explicit and tacit knowledge. Second, the model offers insights on both knowledge transfer and knowledge creation. Third, the model is appropriate to use in the current study as it has been applied in many studies of organizational

learning and new product development (Chang, Hung & Lin, 2014; Li, Huang, & Tsai, 2009; Richtnér, Åhlström & Goffin, 2014).

INSERT FIGURE 1 ABOUT HERE

Figure 1 depicts our study's conceptual model which highlights the effect of R&D intensity, the use of international R&D teams, NPP, and moderating effect of the knowledge creation process. The model shows that the use of international R&D teams is influenced by R&D intensity, and the use of international R&D teams influences NPP. In addition, our model suggests that levels of knowledge creation process strengthened the effect of international R&D teams on NPP. Below section explains and develops hypotheses for each of these relationships.

2.1 R&D intensity and international R&D teams

According to the knowledge-based view of the firm (Grant, 1996), organizational process, systems and practices geared towards knowledge generation and diffusion can inject improvements into the focal organization leading to superior outcomes (Leiponen, 2006). One effective mechanism for doing so is the formation of cross-functional teams to provide opportunities for development and diffusion of new ideas and insights (Leiponen, 2006; Sarin & McDermott, 2003). Increasingly, business success hinges on not just knowledge creation, but also the ability to assimilate and share knowledge across firms (Okhuysen & Eisenhardt, 2002). As Grant (1996, p. 112) observed, "*Knowledge creation is an individual activity… the primary role of firms is in the application of existing knowledge to the production of goods and services*." Indeed, the research and development activities leading to the development and launching of new products are viewed as the 'lifeblood' of many organizations around the globe (Alegre & Chiva, 2008).

R&D teams are generally a group drawn from functional units of the focal organization and/or that of its partners (Huang, 2009; Leiponen, 2006). Past studies indicate that, by drawing individuals from diverse functional backgrounds, organizations are able to accrue benefits encompassing greater innovation, reduced product development cost, and superior product design and functionalities (Sarin & Mahajan, 2001; Frost & Zhou, 2005; Sarin & McDermott, 2003). Although cross-functional teams are generally beneficial, there are factors such as misapplication and group mismanagement that can hamper the development and contributions of team members (Sarin & McDermott, 2003). By bringing together individually-held knowledge to form such a team, organizations are better able to develop a robust knowledge reservoir to power innovation-related activities (Sarin & McDermott, 2003; Paruchuri & Eisenman, 2012), and investment in R&D can also enhance absorptive capacity (e.g., Cohen & Levinthal, 1990). This is more so in cases of international R&D teams, where individuals from different cultural settings bring different experiences and knowledge to the table which enable firms to enhance their new product development capability (Subramaniam & Venkatraman, 2001), which in turn enable them to develop new products. Given that the scarce resources and human capital needed to deliver organizational success are often distributed across inter- and intra-organizations spanning across developed and emerging markets (e.g., Awate et al., 2015; Santistevan & Josserand, 2018), nurturing cross-functional international R&D teams could enhance organizations' ability to initiate and develop new products (Ambos & Schlegelmilch, 2003; Bustinza et al., 2019; Subramaniam & Venkatraman, 2001). Indeed, some studies have suggested cross-functional collaborative efforts can enrich firms' ability to achieve success in product innovation (de Luca & Atuahene-Gima, 2007; Paruchuri & Eisenman, 2012; Tsai & Hsu, 2014). Based on the above discussion, we hypothesize that:

H1: *R&D intensity will be positively related to the use of international R&D teams*

2.2 International R&D teams, knowledge creation process and new product performance

Alongside the increasing importance of knowledge in the global south is the need to develop new products in order to effectively compete and develop competitive advantage. However, at times, acquiring new knowledge fails to translate into superior results. Besides knowledge sharing, forming an international R&D team allows members to develop a wider network ties and lays the foundation for additional knowledge creation process (Huang, 2009). Recent scholarly advances indicate that organizations in the resource-constrained setting of emerging and developing economies are increasingly searching for new routines, structures and processes to improve product and market performance (see Awate et al., 2015; Amankwah-Amoah et al., 2016; Peng, 2014). Some firms have turned to developing or utilizing international teams to achieve this purpose (see Amankwah-Amoah & Debrah, 2011; Amankwah-Amoah & Sarpong, 2014), yet we have limited insights on how the use of international R&D teams can impact on NPP in SMEs of emerging markets. We argue that the SECI spiral can be utilized to gain knowledge and further its creation and utilization in an organization since diverse knowledge can be combined to create new products (Frost & Zhou, 2005; Subramaniam & Venkatraman, 2001). This is likely to facilitate the use of international R&D teams to transform the new product development process within an organization, because knowledge is dispersed across the developed and emerging markets. Firms based in emerging markets could acquire valuable knowledge from international R&D teams and integrate that knowledge for the development of new products. The knowledge acquired from such teams can also enhance the absorptive capacity of emerging economies' firms (e.g., Cohen & Levinthal, 1990; Zahra & George, 2002), and lead to new product development capability and innovation (Subramaniam & Venkatraman, 2001; Paruchuri & Eisenman, 2012). Recently, studies have examined the offshoring of R&D activities and

suggest that such R&D activities are not only driven by low cost factors but also the availability of high skilled human capital (e.g., Demirbag & Glaister, 2010; Rodgers et al., 2017). It is in such context that international R&D teams become extremely important, especially for the emerging economies firms which have a weak resource base to gain useful knowledge (Awate et al., 2015; Khan et al., 2018). Thus, whilst the use of international R&D teams is likely to spur new product performance, their impact is likely to be more potent in driving product performance when the knowledge creation and recombination process is stronger (e.g., Kogut & Zander, 1992). The rationale is that, when firms are stronger in creating knowledge via the SECI process, they are more potent in boosting the effect of the use of international R&D teams to achieve efficiency, growth and profit. The important aspect of international R&D teams is that novel and valuable knowledge can be created through the recombination of existing knowledge which enables to develop new products related capability and improve product performance and innovation (Subramaniam & Venkatraman, 2001; Paruchuri & Eisenman, 2012). Thus, we suggest that:

H2a: *The use of international R&D teams will be positively related to NPP*.

H2b: *Knowledge creation process will have a positive moderating effect on the relationship between the use of international R&D teams and NPP*.

2.3 The mediating effect of international R&D teams

The effect of R&D investment on performance may be more complex than a simple linear effect. As noted, in Hypothesis 1, we proposed that R&D intensity will be positively related to the use of international R&D teams and Hypothesis 2a stated that the use of R&D teams will be positively related to NPP. These two hypotheses link R&D intensity to the use of international R&D teams, and the use of international R&D teams with NPP. This suggests that the relationship between R&D intensity and NPP is hypothesized to be indirect. Thus, the use of international R&D teams serves as an intermediate variable that mediates the

relationship between the independent and dependent variable. This implicitly suggests that the performance effect of R&D intensity is mediated using international R&D teams. While R&D intensity offers the fundamental ingredients for achieving benefits in the relationship, the use of international R&D teams converts R&D intensity into performance outcomes (Frost & Zhou, 2005; Subramaniam & Venkatraman, 2001). International R&D teams can bring unique external knowledge which might not be readily available through other sources for firms based in emerging markets, thus such teams help in the acquisitions of external knowledge for improving new product performance (e.g., Vera et al., 2016). This discussion leads us to hypothesize that:

> **H3**: *The use of international R&D teams will mediate the relationship between R&D intensity and NPP*.

3. Research method

3.1 Study context-Ghana

The data for this study were collected from a sample of Ghanaian firms which have subsidiaries in several African regions (e.g., Economic Community of West African States, Southern African Development Community) and European countries. Several reasons informed our choice of internalizing Ghanaian small and medium-sized enterprises (SMEs). First, in the current circumstances of constrained institutional setting coupled with limited resources, the need for SMEs in Ghana to develop and harness cross-organizational and cross-border teams has become a strategic imperative, thus making Ghana a suitable setting for the study. Second, Ghana remains the easiest place to do business in the West African sub-region (World Bank, 2018), providing it an appropriate context for manufacturing and product development for the international market. Third, Ghana can be described as a representative of sub-Saharan African emerging economies (Hoskisson et al., 2000). For example, Ghana possesses structural attributes such as relatively limited resources compared

with developed economies, less-skilled manufacturing workforces, use of older technologies and relatively small manufacturing sectors, often associated with emerging economies (Malik & Kotabe, 2009). Lastly, there are limited studies in the mainstream business and management field that have focused on the emerging markets of Africa.

3.2 Sample and data collection

We derived a sampling frame from the Ghanaian Company Register (available at http://rgd.gov.gh/). This database contained 57,580 active incorporated companies. We randomly selected 400 Ghanaian internationalized SMEs with subsidiaries in other countries. These firms are much smaller compared to the firms that are internationalizing from other emerging markets such as those from China and India. We then contacted the chief technology officers (CTOs) or vice presidents of technology/innovation by telephone to ask them for their participation in our study. Out of the 400 firms contacted, we identified 261 firms as being involved in international R&D activities. Subsequently, we approached the CTOs or vice presidents of technology/innovation with a questionnaire in person to capture the use of international R&D teams, knowledge creation process and R&D intensity. In return, we received 213 responses in the first survey. Approximately a year after the first survey, we approached the finance and product managers of the 213 firms with another questionnaire in person to capture NPP. We received 201 complete responses; representing a 77.01% response rate. We obtained responses from finance and product managers of the firms because single source data is often associated with common method bias (Podsakoff et al., 2003). The firms represent the following industries: chemicals, pharmaceuticals, electronics, telecommunications, machinery, automotive, financial services, consulting, logistics and food processing. On average, the companies employed 56 employees, and operated in 22 international markets. The average age of the firms was 21 years.

3.3 Measure of constructs

R&D intensity. To measure R&D intensity, we calculated R&D investments as a percentage of total sales between 2012 and 2016. This approach to measuring R&D intensity is well established in the innovation literature (e.g., Sciascia, Nordqvist, Mazzola, & De Massis, 2015).

Use of international R&D teams. To capture 'use of international R&D teams', we utilized a single item adopted from previous studies (e.g., Ambos & Schlegelmilch, 2004; Harzing, 1999; Martinez & Jarillo, 1991). We asked top managers at headquarters to indicate the extent to which subsidiary management used international teams on R&D activities. This item was captured on a Likert scale with anchors 1= not involved; 7= involved very strongly.

Knowledge creation process. We utilized the scale developed by Sabherwal & Becerra-Fernandez (2003) to capture the knowledge creation process. This scale has four dimensions: socialization, externalization, combination and internalization. We used four items to measure socialization ('cooperative projects across directorates', 'the use of apprentices and mentors to transfer knowledge', 'brainstorming retreats or camps', and 'employee rotation across areas'). Externalization was captured with four items ('a problem-solving system based on a technology like case-based reasoning', 'groupware and other collaboration learning tools', 'pointers to expertise, modelling based on analogies and metaphors', and 'capture and transfer of experts' knowledge'). Four items were used to measure combination ('My firm usually adopts web-based access to data', 'My firm usually uses web pages', 'My firm usually uses databases', and 'My firm usually adopts repositories of information, best practices, and lessons learned'). Finally, we measured internalization with three items ('on-the-job training', 'learning by doing' and 'learning by observation'). We calculated the

combined mean of the four dimensions to constitute the variable score for knowledge creation process. Cronbach alpha=0.88

New product performance. We measured NPP by using four items ('revenues from new products or services', 'growth in revenue from new products or services', 'growth in sales of new products or services' and 'profitability of new products or services') (Atuahene-Gima, Slater & Olson 2005). These items tapped the extent to which the firm has achieved its product development objectives on a Likert scale ranging from 1= below expectation to 7= exceeded expectation. Cronbach alpha=0.94.

Control variables. In testing our hypotheses, we controlled for firm size, firm age, new to the market (radical) innovation, industry and organizational slack. Firm size was measured as the logarithm of the number of employees. Firm age was captured as the logarithm of number of years since the firm was incorporated. Organizational slack was captured with three items (Cronbach alpha=0.85) adopted from de Luca & Atuahene-Gima (2007). These items tapped the availability of excess resources to finance new projects. Industry type was a dummy variable coded as 0=manufacturing; 1=service (Wang, 2008). We controlled for industry type because it may determine source of innovation opportunities (Zahra & Nielsen, 2002). Radical innovation was measured with three items (Cronbach alpha=0.92) assessing the newness of the firm's innovation activities (de Luca & Atuahene-Gima, 2007; McGrath 2001).

3.4 Potential biases, validity and reliability

While we used key informants for the data collection, we conducted a validity analysis to establish that the informants were not biased in their responses. We received survey responses from a second member of the top management team in 40 firms sampled for this study. Intra-class correlation coefficients (ICC) for R&D intensity (ICC(1) = 0.42, $p < 0.01$;

ICC(2) = 0.61, $p < 0.01$), use of international R&D teams (ICC(1) = 0.41, $p < 0.01$; ICC(2) = 0.56, p <0 .01), knowledge creation process (ICC(1) = 0.40, $p < 0.01$; ICC(2) = 0.57, $p <$ 0.01) and NPP (ICC(1) = 0.46, $p < 0.01$; ICC(2) = 0.64, $p < 0.01$) show strong inter-rater reliability (Bliese, 1998). This suggests that we used the right informants for the study.

To establish whether non-response bias affects our data, we followed Armstrong and Overton (1977) and compared early and late respondents of managerial and firm characteristics (Greenwood & Nikulin 1996). Our results indicate that the two groups do not differ substantially in terms firm age, firm size, organizational slack, industry and radicalness of innovation. This shows that non-response bias has no influence on our results.

We utilized several techniques to address the possibility of common method bias influencing out results. First, using the Harman's (1976) single factor test, the items loaded on their respective construct. Second, we followed the procedure suggested by Carson (2007) and estimated a combined congeneric measurement model. Specifically, we estimated a CFA model for all multi-item scales together with a common method factor that was estimated to load on all items. By doing so, we controlled for any variance because of collecting data from a single informant. Accordingly, we estimated two competing models. First, we estimated a trait-only model where each indicator loaded on its respective latent factor. The results show adequate fit to the data: χ^2/df = 5.23; RMSEA = 0.03; NNFI = 0.98; CFI = 0.99; and SRMSR = 0.07. Second, we estimated a trait-method model in which a common factor was included to link all the indicators. Model 2 demonstrate good model fit: : χ^2/df = 5.09; RMSEA = 0.05; NNFI = 0.96; CFI = 0.98; and SRMSR = 0.07. A comparison of the two models reveals that Model 2 is not better than Model 1. This suggests that common method variance does not affect our results. Third, we used the approach suggested by Lindell & Whitney (2001) and chose effectiveness in acquiring information and resources, a variable that is not related to the dependent variable, as a marker variable. The result using this method indicates that

effectiveness in acquiring information and NPP had a non-significant correlation of 0.02. Overall, we believe that issues related to common method bias are substantially reduced in our study.

INSERT TABLE 1 ABOUT HERE

Following the assessment of potential bias, we subjected all our multi-item constructs to confirmatory factor analysis (CFA) using LISREL 8.71 to establish the reliability and validity of each construct. Results revealed that composite reliability (CR) and average variance extracted (AVE) are all above 0.60 and 0.50 respectively. We also inspected the highest shared variances (HSV) between the pair of each multi-item construct and compared the HSVs to the AVEs. We found that the AVEs exceeded the HSVs in this study. This indicates that reliability, and convergent and discriminant validities are established in the data (Fornell & Larcker, 1981).

4. Results

We report the means, standard deviations and correlations for all variables in Table 1. To prevent potential multicollinearity problems relating to testing a moderating hypothesis, we mean centred the continuous variables (Aiken & West, 1991). We found no sign of multicollinearity issues given that the highest mean variance inflation factor was 2.17. This value is well below the suggested threshold value of 10 (Neter, Wasserman & Kutner, 1990). The interaction plots were created using the mean-centred values (e.g., Dawson & Richter, 2006). Table 2 presents the results of multiple ordinary least squares (OLS) regressions.

Hypothesis 1 predicted that R&D intensity would be positively related to the use of international R&D teams. As shown in model 4, R&D intensity was positively and significantly related to the use of international R&D teams (β = 0.29, $p < 0.01$). Thus, Hypothesis 1 received support. Hypothesis 2a proposed that the use of R&D teams would be

positively related to NPP. We confirm Hypothesis 2a in Model 5 as the use of R&D teams positively and significantly related to NPP (β = 0.19, p < 0.01). Hypothesis 2b stated the degree of knowledge creation process would have a positive moderating effect on the relationship between the use of international R&D teams and NPP. Therefore, Hypothesis 2a received support. Next, we test Hypothesis 2b in model 6. The results in model 6 show that the positive influence of use of R&D teams on NPP is amplified when the knowledge creation process is greater (β = 0.53, p < 0.01). As shown in Figure 2, the link between the use of international R&D teams and NPP is stronger at high levels of knowledge creation process. Simple slope analyses reveal that the relationship between the use of international R&D teams and NPP is significant when the knowledge creation process is high (t = 2.98, p < 0.01) but not when it is low (t = 0.44, *ns*). Therefore, the results support H2b.

Hypothesis 3 predicted that the effect of R&D intensity on NPP is mediated using international R&D teams. To test the mediation hypothesis, we utilized the established procedures advanced by Baron and Kenny (1986). According to the notion of this method, mediation is established under three main conditions: (1) the independent variable significantly predicts both the dependent and the mediation variable, (2) the mediation variable significantly influences the dependent variable, and (3) the influence of the independent variable on the dependent variable is attenuated when the mediator is included in the regression equation. To establish full mediation, the effect of the independent variable on the dependent should no longer be significant when the mediating variable is added. Partial mediation is established if the effect of the independent is attenuated but remains significant.

INSERT TABLE 2 ABOUT HERE

Following these procedures, the results indicate that the use of R&D teams mediates the effects of R&D intensity and NPP. First, as shown in model 3, R&D intensity significantly

relates to both the dependent variable (NPP) (β = 0.27, p < 0.01) and the mediator (the use of R&D teams) (β = 0.29, p < 0.01). Thus, Baron and Kenny's (1986) first condition is established. Second, we found in Model 5 that the use of R&D teams significantly relates to NPP (β = 0.19, p < 0.01). This revelation meets the second condition for mediation. Third, the influence of R&D intensity on NPP is non-significant when the use of R&D teams is included in the regression equation (β = 0.01, *ns*). Thus, the results satisfy Baron and Kenny's (1986) third causal step for mediation. Overall, the results of this study met the criteria proposed by Baron and Kenny (1986) in as suggested in Hypothesis 3.

INSERT FIGURE 2 ABOUT HERE

To gain additional insight into the results, we utilized the Sobel test (MacKinnon & Dwyer, 1993; Sobel, 1982). The Sobel (1982) test calculates the magnitude of the unstandardized indirect effect and the standard error associated with it. Accordingly, we computed a *z* distribution in order to establish the statistical significance of the indirect effect. The results of the Sobel test support Hypothesis 3. Specifically, the results show that the indirect effect of R&D intensity on NPP (z = 2.94, p < 0.01) was statistically significant.

4.1 Robustness analyses

To establish the robustness of our research model, we performed several analyses. First, we estimated an OLS regression model with only profitability as our dependent variable instead of NPP measure. Our findings remained substantially the same: the use of international R&D teams was positively and significantly related to profitability (β = 0.22, p < 0.01), the degree of knowledge creation process positively moderates the effect the relationship between the use of international R&D teams and NPP (β = 0.41, p < 0.01). Therefore, we confirm Hypothesis 2a and Hypothesis 2b using profitability as our dependent variable. Second, we

went beyond the usual mean centring approach to investigating multicollinearity by randomly drawing 90% of the sample, contending that multicollinearity will result in unstable regression coefficients (Echambadi & Hess, 2007). Using this approach, we found that all the regression coefficients remained stable in terms of magnitude and direction. This indicates that the results are not influenced by multicollinearity.

Third, we followed the approach suggested by Landis & Dunlap (2000) and assessed causality between R&D intensity and NPP. Accordingly, we set R&D intensity as the independent variable and NPP as the dependent variable and tested the linkage between the two. We found no relationship between NPP and R&D intensity, suggesting no reverse causality in our data (Cao, Gedajlovic, & Zhang, 2009.) We examined whether degree of knowledge creation process is an antecedent of R&D intensity. Controlling for firm size, firm age, industry sector, organizational slack and radical innovation, we found no significant relationship between knowledge creation process and R&D intensity (β = 0.02, *ns*).

Finally, we utilized the structural equation (SEM) approach in Mplus path analysis (Muthén & Muthén, 2010) to add the proposed moderator simultaneously in the research model. The path coefficients support the mediating role of degree of knowledge creation process on the relationship between the use of international R&D teams and NPP. We received adequate fit for the model: (χ^2/df = 1.47, RMSEA = 0.02 CFI = 0.99, TLI = 0.98). The findings show that Hypothesis 1 (γ = 0.16, p<0.01); Hypothesis 2a (γ = 0.17, p<0.01); Hypothesis 2b (γ = 0.49, p<0.01); and Hypothesis 3 (ab = 0.16, p < 0.01; 95% CI [0.11, 0.29]) all support the previous findings.

5. Discussion and conclusion

The constant flux in global demand patterns and declining growth potential in developed markets are driving firms to find new business models for innovation. Firms across both

emerging and developed markets are rapidly internationalizing their R&D functions and utilizing international teams to develop new product development capability (Awate et al., 2015; Frost & Zhou, 2005; Subramaniam & Venkatraman, 2001). By tapping into diverse knowledge sources, firms can enhance new product development capability and performance. Indeed, extant research suggests that R&D expenditure plays a major role in NPP (e.g., Ruiqi, Wang, Xu, & Yuan, 2017; Sharma, Davcik, & Pillai, 2016). However, the underlying mechanisms through which R&D intensity improves new product performance are relatively underexplored.

In emerging markets, product demand tends to be mostly in the low-end and resources required to embark on R&D activities are scarce. In this study, we contend that R&D intensity drives NPP and put forth a moderated mediation model considering how heightened R&D expenditure can stimulate NPP in an emerging economy—Ghana. In addition, we investigated when international R&D teams drive NPP by introducing a firm's knowledge creation process as the contingency factor between international R&D teams and NPP. We found that the effect of R&D intensity on NPP is mediated by international R&D teams. The results also show that the use of international R&D teams spurs NPP and this linkage is amplified at high degrees of knowledge creation process.

The findings of the study offer several vital implications for theory and practice in the context of emerging markets' firms. Theoretically, the finding suggests that the use of international R&D teams mediates the effect of R&D intensity on NPP contributes to earlier research exploring the extent to which R&D expenditure spurs performance (e.g., Jiang, Waller, & Cai, 2013; Rosenbusch, Brinckmann, & Bausch, 2011). While some studies have ignited debates on whether R&D intensity ultimately contributes to firm performance (e.g., Kothari, Laguerre, & Leone, 2002; Liao & Rice, 2010), our findings confirm extant research that noted that investment in R&D can drive future performance (e.g., Ruiqi, Wang, Xu, &

Yuan, 2017). In so doing, we open the black box of the mediating mechanisms relating to how R&D intensity affects NPP in an emerging economy.

Second, the findings of this study indicate that the use of international R&D teams drives NPP is an important addition to the traditional explanations linking globally dispersed R&D activities to foreign manufacturing and marketing operations (e.g., Hakanson & Nobel, 2000; Pearce & Singh, 1992). Indeed, firms tend to derive competitive advantage on their capability to integrate knowledge on the global scale by investing in R&D teams (Chiesa, 1996; Nohria & Ghoshal, 1997). Third, we demonstrate that the effect of the use of R&D teams on NPP is contingent on knowledge creation process. Thus, we provide a more nuanced understanding of the contingent effect of international R&D teams on NPP. While prior research has considered technological as well as the market mandate as contingent factors (Ambos & Schlegelmilch, 2004), our study provides a contingency perspective and reveals that the knowledge creation process provides an important boundary condition for the effectiveness of the use of international R&D teams in enhancing NPP. In doing so, we complement previous studies (Ambos & Schlegelmilch, 2004; Birkinshaw, 2002) and provide a better understanding of under what conditions the usage of international R&D teams enhances performance.

Finally, this study used data from Ghana, a sub-Saharan African emerging economy, to show that R&D investments and utilization of international R&D teams can serve as an enabler for new product performance in emerging markets' firms that lack critical resources in their home markets. Accordingly, the study contributes to research on emerging-market firms in uncertain institutional setting (Luo & Bu, 2018) by examining firms' R&D investments in Ghana and demonstrating how emerging country-based firms are likely to spur new product performance when R&D investments are greater. This is an important addition to the strategy and international business literature because very little effort has been devoted

to investigating how R&D investments in an emerging country drive a new product performance via international R&D teams and how knowledge creation processes condition the effect of international R&D teams on NPP. This addition offers a rich emerging market perspective for theory building.

Our study has strong practical implications too. First, the knowledge that international R&D teams mediate the effect of R&D intensity on NPP can guide international managers to improve product performance using R&D activities and networks. Moreover, the results have vital implications for helping advanced nation ventures interact with emerging market ventures. Thus, developed countries can have an important insight as to how to improve product performance in emerging markets using R&D investment and teams. Second, the finding that a firm's knowledge creation process is contingent on the relationship between the use of international R&D teams and NPP is important for managers to spur performance. Specifically, managers are likely to understand when the use of international R&D teams can yield superior performance. Overall, our research topic and contexts clearly show that this study is positioned to extend our theoretical understanding and to guide managerial implications as well.

6. Limitations and future research directions

Despite the strength of our research design-we collected data over time from different respondents – helping us to attenuate inflated correlations and common method bias (Podaskoff et al., 2003), this study has some limitations that open up additional avenues for future research. First, we did not utilize manipulation strategy or random assignment to help us make causal claims. Instead, we relied on theory and time-lagged data to test our hypotheses. Though we controlled for several variables that are deemed to have influence on product performance (Atuahene-Gima, Slater & Olson 2005), we did not account for prior

venture growth. We encourage future studies to control prior growth. Second, we relied on perceived product performance, which might be biased. However, this should be considered against the fruitfulness of insights obtained from investigating the behaviour of new ventures, given that managers' perception of a firm's success or failure relative to its rivals has been found to have a stronger motivational effect on managerial choices (Dess & Robinson, 1984; Powell, 1992). We encourage future research to obtain objective financial data to measure NPP. Third, we relied on internationalizing firms from Ghana, so the findings should be evaluated in the context of an emerging country. Though Ghana offers a rich context in which to examine the effect of R&D investments and teams on new venture performance from an emerging economy perspective, we suggest that other emerging economies such as Ethiopia, India, South Africa and Vietnam may offer a unique contextual insight for theory development. Fourth, it would be useful to examine the involvement of customers and examine the co-creation processes of new product development and performance (e.g., Cui & Wu, 2016).

Fifth, emerging markets are aggressively acquiring firms based in developed markets, thus future studies could examine the role of such acquisitions in new product development capability of emerging markets' firms. Sixth, there is a scope to examine the mandate given to the subsidiaries, and how the industry, sector and home and host markets' factors influence new products' performance and new product development capabilities in emerging markets' firms. Seventh, there could be additional moderators such as the role of the top management teams, firms' learning and market orientations that may influence the use of international R&D teams, thus future studies could examine the impact of these moderators on new product performance across different firms. Finally, we used a single item to capture 'use of international R&D teams', which limits the robustness of our scale and

model. Future studies could seek to develop a more qualitative and longitudinal study to develop additional items and test them in a similar context.

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Table 1: Descriptive statistics and correlations

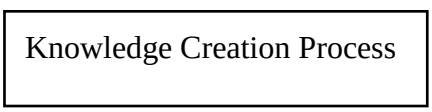
	Variables	Mean	S.D.	1	2	3	4	5	6	7	8
1.	Firm size (employees)[a]	56.14	151.35								
2.	Firm age (years)[a]	21.04	2.16	-0.02							
3.	Industry dummy	0.52	0.49	0.03	-0.12						
4.	Radical innovation	3.85	0.69	-0.08	-0.05	0.12					
5.	Organizational slack	3.58	0.69	0.19**	0.09	0.06	0.08				
6.	R&D intensity	0.09	2.41	0.15*	-0.15*	0.23**	0.22**	0.27**			
7.	International R&D teams	3.64	0.59	0.12	-0.07	0.13	0.19**	0.15*	0.26**		
8.	Knowledge creation process	4.22	1.04	0.06	-0.02	0.05	0.28**	0.11	0.14	0.07	
9.	New product performance	3.33	1.47	-0.04	-0.01	-0.13	0.24**	0.19**	0.21**	0.16*	0.06

N=201. [a] Logarithm transformation of original value. *p < 0.05; **p < .01 (2-tailed test); S.D. = Standard Deviation

Table 2. Findings of the moderated mediation regression analyses

Variables	Model 1 New Product performance	Model 2 New Product performance	Model 3 New Product performance	Model 4 International R&D teams	Model 5 New Product performance	Model 6 New Product performance
Control Variables						
Firm size[a] (Employees)	-0.04	-0.04	-0.05	0.12*	-0.07*	-0.07*
Firm age[a] (years)	-0.03	-0.04	-0.03	-0.08*	-0.04	-0.04
Industry dummy	-0.14**	-0.14**	-0.13**	0.14**	-0.14**	0.13**
Radical innovation	0.25***	0.26***	0.23***	0.20***	0.23***	0.23***
Organizational slack	0.22***	0.23***	0.22***	0.17***	0.23***	0.24***
Knowledge creation process		0.10*	0.10*	0.09*	0.11*	0.10*
Main effect						
R&D intensity			0.27***	0.29***	0.01	0.29***
Mediating effect						
International R&D teams					0.19***	
Moderating effect						
International R&D Teams x knowledge creation process						0.53***
Model Fit						
F-value	2.01*	5.75***	8.12***	9.16***	11.68***	15.52***
R^2	0.11	0.19	0.23	0.29	0.36	0.42
ΔR^2	-	0.08	0.05	0.06	0.07	0.06

N=201. t-values are reported. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$ [a]Log transformation of original value



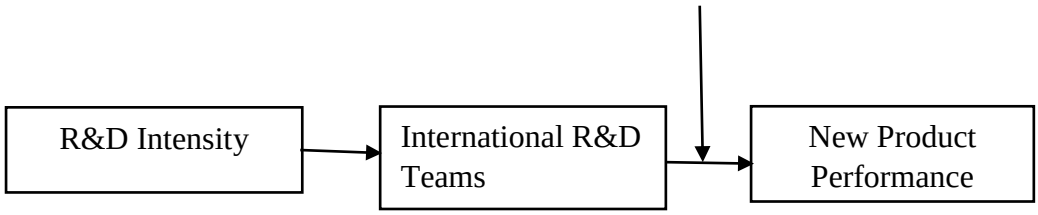


Figure 1. Conceptual Model

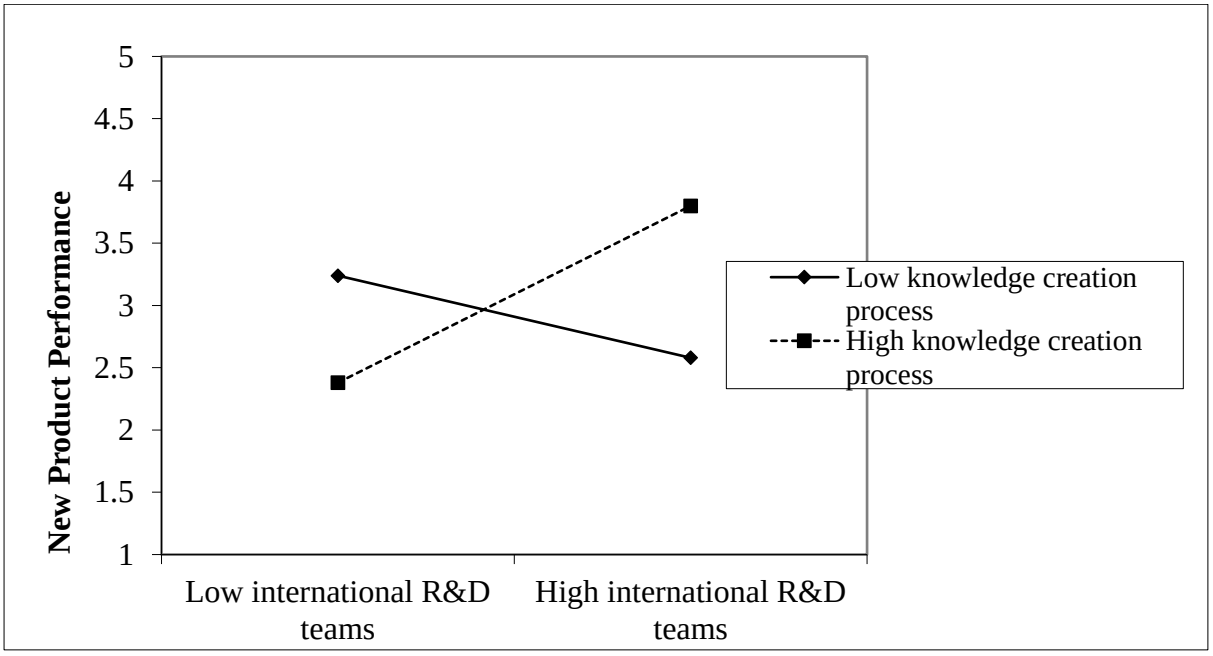


Figure 2. Interaction of international R&D teams with knowledge creation process on NPP